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A SURVEY OF UNREINFORCED MASONRY BUILDINGS IN SAN FRANCISCO

A Summary Report

by

Seismic Investigation and Hazards Survey Advisory Committee (SIHSAC)

and

Department of Public Works, Bureau of Building Inspection

March 1987

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EXECUTIVE SUMMARY

It has long been recognized that older unreinforced masonry buildings in San Francisco are likely to be a severe hazard to life and limb during the next damaging Bay Area earthquake. For this reason, identification of these buildings and abatement of the hazard they pose is mandated by City policy. The results of a recently completed survey show that there are about 2100 unreinforced masonry buildings in the City. Using survey and other information, it is anticipated that an ordinance to strengthen these buildings to some acceptable minimum safety standard will be drafted during 1987. The content of this draft ordinance will be governed by technical structural concerns. However, it will consider social, economic, legal, and aethestic implications of unreinforced masonry building hazard abatement in the City.

REF 624.1762 Se454

Seismic Investigation and Hazards Survey
A survey of unreinforced masonry buildings in 1987.

INTRODUCTION

The Seismic Investigation and Hazard Survey Advisory Committee (SIHSAC) has been charged by the San Francisco Board of Supervisors to make recommendations for improving the seismic performance of existing unreinforced masonry buildings (UMB's) constructed in the City prior to 1948 (Section 204.1.E of the 1980 Municipal Code). In partial fulfillment of this charge, SIHSAC submitted to the Board (SIHSAC report of April 6, 1981) the recommendation that San Francisco approach the abatement of the hazard posed by these older UMB's by adoption of an ordinance patterned generally after the Applied Technology Council's 1978 "Tentative Provisions for the Development of Seismic Regulations for Buildings" as illustrated by the Los Angeles City Earthquake Safety Ordinance of 1981. As an essential first step toward drafting such an ordinance for San Francisco, it was further recommended that an accurate census of older UMB's be performed recognizing that no further work could be done without this census. The purpose of this report is to present summary information gathered by the Bureau of Building Inspection (BBI) of the San Francisco Department of Public Works during 1985, 1986, and 1987 on the inventory of UMB's in the City and County of San Francisco. SIHSAC and several City agencies anticipate that this and other information currently being gathered will provide the basis for a draft San Francisco UMB hazard abatement ordinance to be submitted to the Board of Supervisors in 1987.

Before and during the period that BBI was performing the UMB survey, the State of California was considering ways to encourage local jurisdictions to address the hazard that these buildings represent to the health and safety of the public. After several false starts, the California Legislature passed, and the Governor signed into law, SB547 which requires, in part, that local building departments identify all pre-code UMB's by the end of 1989, and provide this information, including

building use and occupancy load, to the local legislative body and to the California Seismic Safety Commission. The current summary report, therefore, partially satisfies both San Francisco and State requirements.

SOME BACKGROUND

It may be useful to touch here on the answers to several important questions. Why are UMB's of particular concern? Why only older UMB's? What will be gained from a detailed census of these buildings? What follows the census?

Unreinforced masonry buildings have exterior walls of brick, stone, concrete block or similar materials, and wood or concrete slab floors and roofs. By far the most common type of UMB in San Francisco is one with a brick exterior and wood floors and roof. UMB's are "unreinforced" because their masonry walls do not have any steel or other type of reinforcement and are typically not well anchored to the floors or roof. UMB's are designed to resist gravity loads. They are not designed specifically to withstand significant dynamic side-to-side forces. If a typical UMB were to be placed on a movable table and slowly tilted, it would soon suffer severe damage and might collapse. Of course side-to-side forces are imposed on all structures during an earthquake.

It would be an exaggeration to believe that all UMB's are hazardous. Examples exist of good performance of some UMB's in strong earthquakes due to quality workmanship during their construction, small openings and adequate wall anchors, or perhaps the capricious nature of shaking during an earthquake. Nor are UMB's automatically a collapse hazard. Even after external walls fail, internal wood partitions, although not designed for that purpose, may be adequate to support the floors and roof long enough for most occupants to leave the building. Nevertheless, as a group UMB's have repeatedly shown that they very often present a threat to life and limb to both their occupants and passers-by on the street during a strong earthquake. Although not the only type of hazardous building, UMB's figure prominantly in scenes of destruction and tragedy following earthquakes throughout the world. As a group, UMB's suffer more damage for a given level of ground shaking than any other type of structure. This is why UMB's are of particular concern.

Why are only older UMB's of concern? This is simply because there are no younger UMB's. The 1933 Long Beach earthquake marked the beginning of earthquake-resistant design provisions for masonry buildings. Many buildings of this type were still constructed after 1933, however, until local codes restricted the use of unreinforced masonry. In San Francisco, the adoption of a building code in 1948 requiring seismic design provisions for all buildings essentially eliminated the UMB from new construction. A few UMB's permitted in 1948 were built in the ensuing several years.

What will be gained from an accurate UMB census? The general features of a UMB hazard abatement ordinance from a technical point of view are clear: some strengthening of UMB's to withstand damaging earthquakes should be done expeditiously. Details of how much strengthening can be accomplished and how soon it can be done depend on social and economic as well as technical factors. Specific details of a UMB hazard abatement ordinance for San Francisco must be tailored to the specific character of the City and they must, therefore, recognize and consider not only the City's vulnerability to damaging earthquakes but also the City's demography, cultural heritage and history, housing needs, financial resources, and ambiance. SIHSAC members feel that agreement by all concerned on ordinance details may never take place, but that abatement of the UMB hazard deserves careful attention that can only be possible if the information used to draft an ordinance is consistent, credible, and accurate. A census of which buildings are UMB's, their number, locations, and uses, is of fundamental importance to planning a successful UMB hazard abatement program for the City.

What follows the census? While an important step, a census is only a means to an end. The goal of a UMB ordinance is to allow the City and its citizens, after the next damaging earthquake in San Francisco, to know that all reasonable and prudent steps were taken to abate this hazard; to know that the effects of foreseeable damage and destruction were minimized to the extent possible. An enforcable and well-written ordinance will be an important step in this direction.

INFORMATION SOURCES, LIMITATIONS, AND COLLECTION PROCEDURES

The summary data on pre-1948 unreinforced masonry buildings (UMB's) presented in this report has been developed over the course of more than two years from existing City files in several City Departments, from published private-sector maps, from field observation of each building, from considerable cross-checking of initial survey data, and from the building owners themselves. Nevertheless, inaccuracies may remain in the current version of the survey results. We do not believe that they will affect the general conclusions presented in the following section.

So that any user of the information contained in this summary report can know where the data came from and how it was collected and compiled, a brief description of the survey procedure is given here.

The starting point for the UMB survey was the City collection of Sanborn maps. These maps are compiled by a private source primarily as a service to fire insurance companies. They show for each block of the City all buildings, their configuration, and their construction type as this bears on expected building fire resistance. The Sanborn maps were used as the basic source of information on construction type.

Construction type on the Sanborn maps is denoted by a color code. Buildings coded red are described in the index to the Sanborn maps as unreinforced masonry, buildings coded blue are concrete or steel frame buildings with wood floors and roof and incombustible exterior walls, orange-coded buildings have concrete or steel frames, incombustible exterior walls and roof, and floors that may be either combustible or incombustible, and buildings coded yellow are wood frame structures. Buildings that are composites of more than one construction type are color coded accordingly. An example of the Sanborn map for two City blocks is shown in Figure 1.

The Sanborn Company updates its maps twice a year to show all building changes. San Francisco has book and microfiche versions of these maps that are updated annually. The latest version available, that of 1986, was used for the current survey.

Using copies of the Sanborn maps, two Department of Public Works building inspectors walked around each block of the City to verify the construction-type color code. This was done to help assure the basic accuracy of the survey results. At the same time some other important information was recorded for all non-woodframe buildings. For example, it was noted whether the structure had a soft story (usually where the supports for the second story are unbraced columns), throughwall anchors (where the floors and roof of a UMB are tied to exterior walls as evidenced by exterior metal plates), or long span (where the distance between walls spanned by the roof exceeds 24 feet).

All field survey data were entered into a computer file and matched, using building block and lot number, with additional information from the City Assessor's Office. The principal information taken from Assessor Office records was building story count, use classification (for example, public buildings - P, commercial buildings - C, apartment buildings - A), year built, and square footage of floor space.

The Sanborn map, field survey, and Assessor's Office records indicate that there are approximately 6000 non-woodframe buildings constructed in San Francisco before 1951. Of these, about 2100 are UMB's. For these UMB's additional information of importance has been collected from several other sources. A City Planning Department computer data file has provided the census tract number for each building and whether it has been identified as a building of historic significance or is located in an historic district. The Division of Apartment and Hotel Inspection of the Bureau of Building Inspection has provided data on the number of apartment units, tourist guest rooms, and residential guest rooms in each identified building. All owners of properties identified as UMB's have been requested by letter to provide any information that they might have indicating that their structure was not, in fact, an UMB.

Finally, specialized information on each UMB is currently being added to the data base. For example, parapet enforcement data (from BBI), seismic upgrading information (where available from owners or private structural engineering and architect firms), and foundation conditions (from a data

file of the Association of Bay Area Governments) are all being placed in the UMB information data base as they become available.

The chance for error in compiling, entering, and merging a variety of information from a variety of sources must be recognized. Initial results showed a number of cases of missing or conflicting data. Almost all of these problems have now been corrected by verification of building block and lot numbers among different data sources, of addresses, and of building shape from the Sanborn maps. Several hundred follow-up field checks of buildings with questionable data have also been performed. Therefore, the data presented in this summary report has been compiled and checked whenever an obvious problem arose. Some errors undoubtedly remain and should be brought to the attention of BBI (558-4505) whenever or wherever they are found. These are not expected to be numerous.

SUMMARY OF UMB INFORMATION

The total building stock of the City of San Francisco is about 155,000. Of these, about 2100 are UMB's. Because of building code provisions, none of these buildings was permitted after 1948 (or built after 1951). Most of the City's UMB's are much older. Over half these structures were constructed in the six years following the great 1906 San Francisco earthquake. Neglecting buildings carried in the Assessor's files as being built in 1900 (a year assigned to public UMB's and pre-1900 UMB's whose actual construction date is unknown), the average age of a City UMB at the beginning of 1987 is just under 75 years. Figure 2 shows a histogram of the number of UMB's by year built.

Most of the City's UMB's are lowrise structures. Over half are two or three stories high. About another one third are either one or four stories high. The tallest is a nine story building. Figure 3 is a histogram of the number of UMB's by story count.

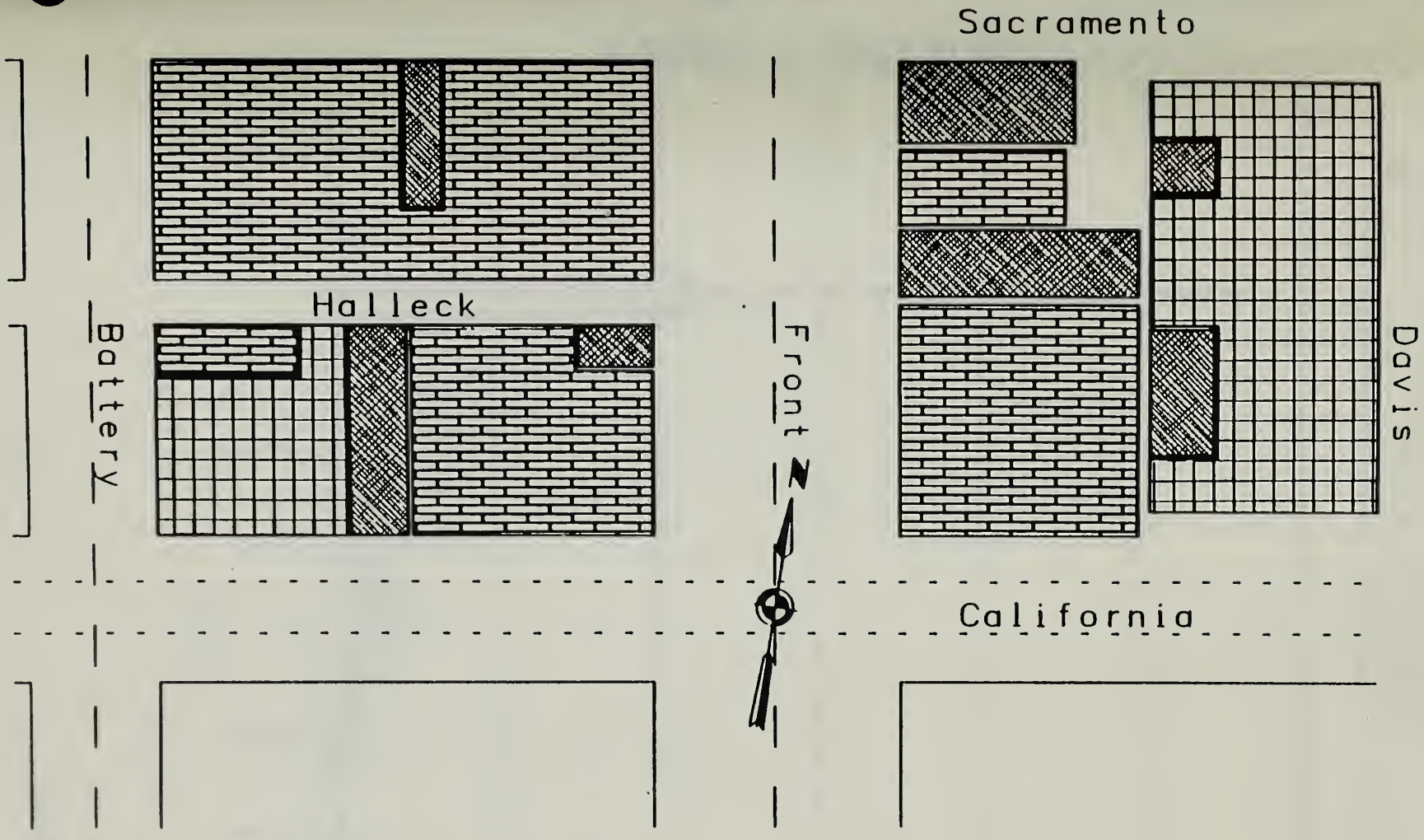
The single largest use of UMB's in the City is commercial. About one out of every four UMB's is carried in the Assessor's files by this use class description. Other common uses are for apartments (about 400 buildings), industry (about 330 buildings), second class hotels (about 255 buildings), and offices (about 220 buildings). Within the City's UMB's are just under 11,000 apartments, 10,500 hotel residential units, and 5500 tourist hotel units.

The distribution of UMB's around the City is shown in Figures 4 and 5. Figure 4 shows the UMB building count by block in increments of none, 1 to 5, 6 to 10, 11 to 20, and over 20 UMB's per block. Figure 5 shows UMB living units (apartment, residential hotel, tourist hotel) count in increments of none, 1 to 150, 151 to 300, and over 300 per block. Clustering of both buildings and living units is apparent in several areas.

Some selected pertinent information for all currently identified UMB's, listed alphabetically by street address, is attached as Appendix 1 to this report.

USES OF THE UMB SURVEY INFORMATION

The compilation of UMB data summarized in this report has been performed as an important quantitative intermediate step in the ultimate abatement of the earthquake hazard posed by such buildings. It is anticipated that this data will be used, in conjunction with other information bearing on the social, economic, legal, and aesthetic implications of UMB hazard abatement, to draft a hazardous building abatement ordinance for the City and County of San Francisco. Initial steps have been taken to begin the ordinance drafting process.



Brick wall, wood roof. May have concrete floors. (Red)

Combustible roof with incombustible exterior walls. May have steel frame. (Blue)

Incombustible roof with incombustible exterior walls. May have steel frame. (Orange)

SAMPLE SANBORN MAP

FIGURE 1

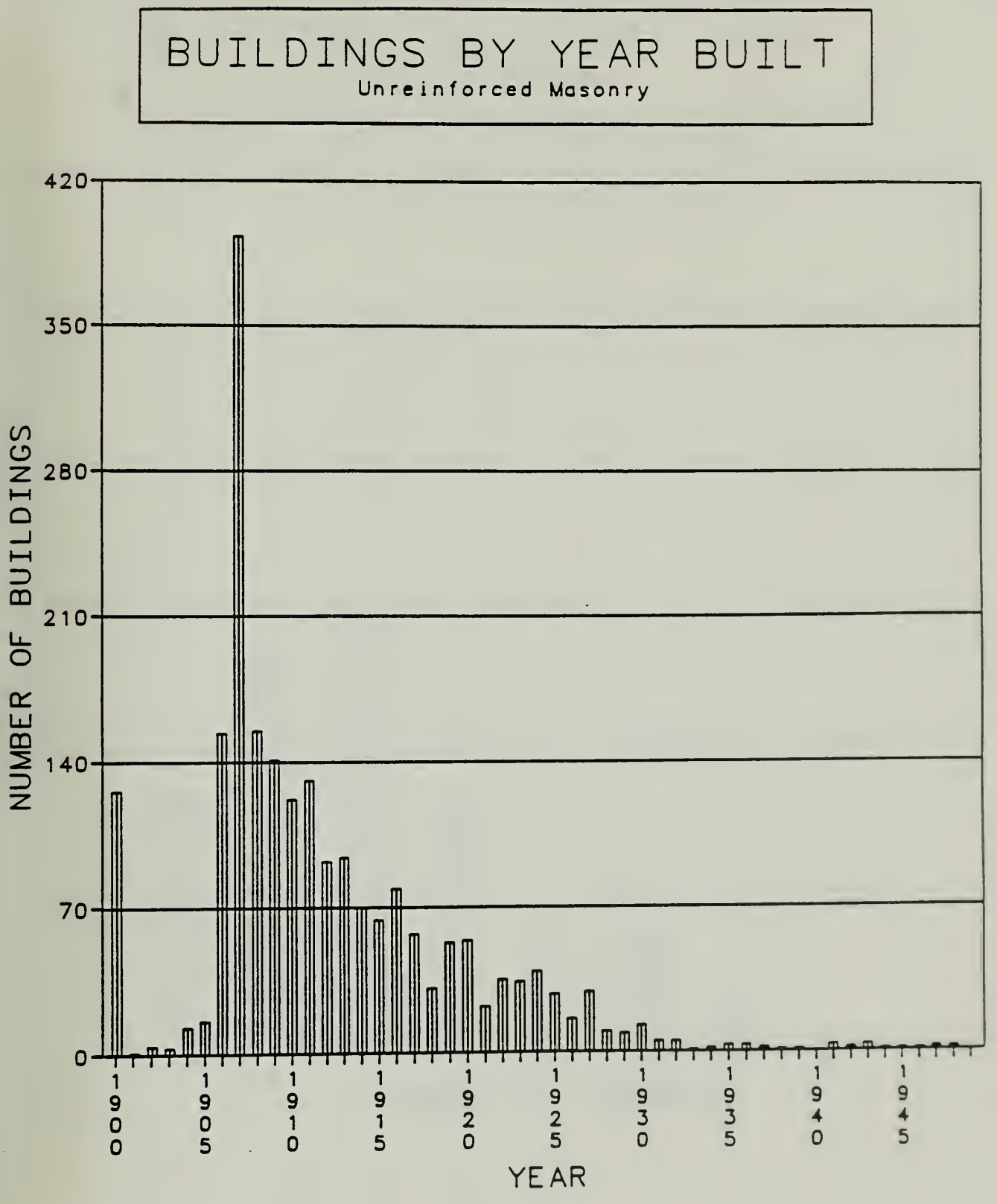

BUILDINGS BY YEAR BUILT
Unreinforced Masonry
NUMBER OF BUILDINGS
420
350
280
210
140
70
0
1900
1905
1910
1915
1920
1925
1930
1935
1940
1945
YEAR

FIGURE 2

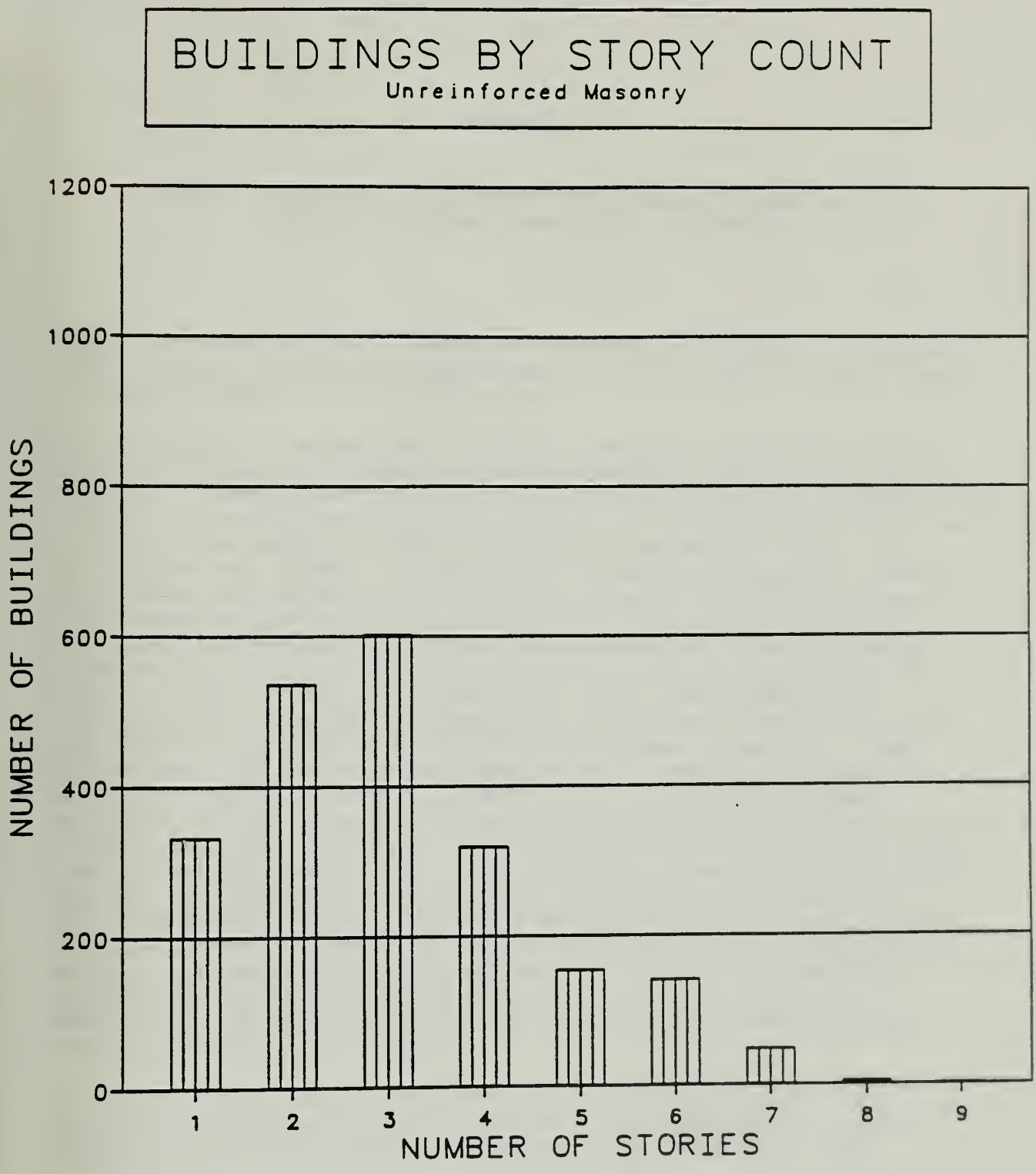

BUILDINGS BY STORY COUNT
Unreinforced Masonry
NUMBER OF BUILDINGS
1200
1000
800
600
400
200
0
1
2
3
4
5
6
7
8
9
NUMBER OF STORIES

FIGURE 3

APPENDIX 1

A Working List of Privately-Owned Unreinforced Masonry Buildings within the City and County of San Francisco

Buildings listed in this appendix are ordered alphabetically by street name. Numbered streets and avenues appear at the end of the list ordered by the first digit of the street number.

For each building on the list, the street address is followed by block and lot information adequate to uniquely specify the structure in City records. A simple block (BLOCK NMBR and BLOCK SFX) and lot (LOT NMBR and LOT SFX) designation are usually sufficient for this purpose. For a few buildings, lot sequence number (LOT SEQ) is also needed. Other data include the year in which the structure was built, the number of stories it contains, the number of living units in the building (if more than two) separated into apartment, tourist hotel, and residential hotel units, and whether the building has been designated as historic or as being within an historic district of the City ("Y" if "yes", blank if "no"). Finally, there is a column with a code (OWNER RSPNS CODE) indicating the nature of owner response to a letter mailed in January to all identified unreinforced masonry building owners. An "A" in this column means that the owner has supplied some documentation that the building is not a UMB or that it was formerly a UMB that has been strengthened. When this information is verified these buildings will be removed from the working list. A "B" means that the owner confirmed that the building is a UMB, was not sure, or indicated that some parapet work only had been performed. A "C" appears in this column if the owner indicated that the building was not a UMB or was a strengthened UMB with or without further comment, but without documentation. A blank in this column means that there was no response as of the last update of the working list. Several buildings were noted by owners as recently demolished. This was verified by BBI inspectors, and these buildings have been removed from the list.

As stated on each page of the appendix, this is a working list only. It will be updated as new information becomes available and is verified. Please bring any corrections or additions to the attention of BBI (558-4505).